Invited Commentary: Second-hand smoke is an under recognized risk factor for cognitive decline that may also be a modifiable risk factor for dementia

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Abstract

Pan and colleagues report findings showing that second-hand smoke (SHS) exposure is associated with cognitive decline over two years in both middle-aged and older Chinese women who never smoked and also report a dose-response relationship. SHS exposure affects vulnerable people disproportionately as they have less control or choice over their living and working environment. Smoking is an established risk factor for dementia, but recent evidence reports on dementia risk increase have not included SHS. Many epidemiological studies collect data on smoking but not SHS exposure. SHS may be one of the most prevalent and modifiable risk factors for cognitive decline and therefore represents a major potential target for dementia risk reduction. Given the high prevalence of smoking in China and other parts of the world, there is an urgent need to raise awareness of SHS reduction as part of global and national strategies to reduce cognitive decline and dementia, and to introduce legislation that protects non-smokers and vulnerable children and adults from SHS.

Keywords: prevention, risk factor, cognitive decline, dementia

The current study by Pan and colleagues (1) provides new evidence on the risk of second-hand smoke (SHS) for cognitive decline in mid- and late-adulthood, highlighting a risk factor that has not been included as a priority in recent influential evidence reports (2, 3) on dementia prevention. This builds on previous cross-sectional research on adults aged 60+ from five provinces in China (4) reporting an association between dementia diagnosis and exposure to environmental tobacco smoke. People who develop cognitive deficits in middle age are likely to have greater risk of late-life dementia than adults who develop cognitive impairment for the first time in late-life (5).

By 2030, 66 million adults globally are expected to have dementia (6) due to population ageing. Cognitive impairment that is not severe enough to meet criteria for a diagnosis of dementia has a prevalence of 16.8% in adults aged > 65 in Canada (7) and 20% in adults age > 70 in the United States (8). With the lack of any significant breakthrough in discovering an effective treatment or cure for dementia or Alzheimer's disease (AD), risk reduction is the mainstay of current dementia prevention programs.

Findings on SHS and cognitive decline in the Chinese Health and Retirement Longitudinal Study (CHARLS) are particularly important because the study is representative of the population and longitudinal, and has measures comparable with other national surveys including the US Health and Retirement Study (9). This enables cross-national comparison of rates of exposures for late-life disease. Within China, exposure to SHS affects approximately 50% of the population (10, 11) and within the CHARLS dataset there was an average of 30-years of exposure. The impact of SHS on cognitive decline is likely compounded by other highly prevalent risk factors that reduce brain and cognitive reserve. Globally, the most prevalent risk factor for dementia is low education (up to lower secondary school according to the International Standard Education Classification) which affects 40% of the world population (12) and up to 70% in China (13).

The article (1) reports data on middle age which has been identified as a crucial period for focussed lifestyle and vascular risk reduction interventions (14-17). The authors report that SHS was associated with more rapid memory decline but not decline in cognitive status measured using a Telephone Interview version of the Mini-mental state examination (MMSE). The MMSE is designed to detect cognitive impairment and has ceiling effects in the normal population. It usually lacks sensitivity to detect cognitive decline in normal ageing, although significant change in the sample was detected over the follow-up period of two years. The extent of decline on the cognitive measures in CHARLS due to SHS per

annum was one third of that due to ageing. However, it is possible that there was further cognitive decline not captured by the limited cognitive test battery in the study.

Other risk factors, including low education, rural setting and depressive symptoms, were associated with cognitive decline in the study and are consistent with the wider literature. The results provide some possible explanations for observed demographic differences in cognitive impairment/dementia (18) with rural Chinese women having higher rates of dementia than rural males and urban dwelling women. The incidence of dementia in China is similar to that in Europe and the United States (19) and prevalence rates vary in reports according to region and urban and rural setting, with generally higher rates of dementia in women (20-22).

Previous research from five provinces in China has (4) reported an increased risk of dementia and AD associated with environmental tobacco smoke. Findings from the Pan et al (1) paper provides a potential explanation for the observation of increasing prevalence of dementia in China, particularly in women (23) and suggest that without intervention, high rates of incident dementia (24) may occur. The higher rates of smoking and exposure to SHS in China compared with the United States and Europe may in part explain differences in incidence and prevalence rates between countries. However US smoking data (25) reveals large disparities in smoking rates that are associated with socio-economic status and disadvantage with the majority of US smokers now being socially disadvantaged. Given that smoking and exposure to SHS are associated with increased risk of cognitive decline and late-life dementia, these data suggest that the long-term disparities in health and health behaviour of adults, and associated environmental exposures of children to factors such as SHS (26), may translate into disparities in dementia incidence in late-life in the US and other countries.

In addition to including older adults, the Pan et al article (1) reports findings for middle-aged adults, who had completed two survey interviews during 1-2 years of follow-up in CHARLS. Middle age is also when other modifiable risk factors for cognitive decline occur such as high serum cholesterol and overweight or obese body mass index (BMI). Previous research on the impact of SHS has focussed on early life development or very old adults. Hence this report fills a gap in the life-course evidence-base on the impact of SHS exposure. Other recent reports of the impact of air pollution on risk of cognitive impairment/dementia (27, 28) suggest that strategies for dementia risk reduction need to focus more broadly on environmental factors impacting on health.

The study also raises further questions and topics for investigation. It is limited by the restriction in gender to women, and SHS measured from husband's smoking at home. Data are needed to confirm a similar effect of SHS on men. Including SHS exposure at work and in other places would give a full picture for the impact of SHS on cognitive impairment. The longer-term follow-up of the participants who did not have cognitive impairment at baseline will help further clarify the causal effect of SHS on cognitive impairment. Adjustments in the data analysis including other important confounding factors, such as BMI and stroke will help assess the extent to which SHS increased the risk of cognitive impairment. The interaction between SHS and other known risk factors for dementia such as the Apolipoprotein e4 genotype, and other vascular risk factors also needs exploration. Concomitant neuroimaging data would provide information on whether smoking and SHS have similar impacts on vulnerable brain regions and the accumulation of tau and amyloid pathology. Further follow up of the sample for incident Alzheimer's disease and vascular dementia would also allow for evaluation of how these results translate into risk factors for dementia.

The reversibility of risk associated with SHS is not known. One study of older adults on a smoking cessation program found that successful quitters showed reduced brain atrophy compared with unsuccessful quitters, and cognitive trajectories more similar to never smokers in a control group (29). However there appears to be a lack of data on removal of risk of SHS and subsequent impact on cognitive function.

SHS exposure differs from many other behavioural risk factors for chronic disease because individual behaviour affects others. Infants and children or those with low mobility may be unable to move away from environments with SHS. Adults with dementia or cognitive impairment may have a higher level of SHS exposure within the home as they may be less mobile and not recognise the harmful effects of SHS, compounding effects in this group. This raises questions about public responsibility for exposure to SHS and the role of governments in regulating exposure. In Australia, laws governing SHS exposure have been instituted to protect children. For example, adults are not allowed to smoke while driving with children. Most jurisdictions also prohibit smoking in workplaces, on public transport, airlines and restaurants. However, although the Chinese legislation called for a ban on smoking in all public places over the last few years, progress has been hindered by the high prevalence of smoking and a general view that smoking is acceptable (10) and there has been no reduction in the prevalence of SHS exposure in China (30). In the past the health concerns in relation to SHS have focussed on cardio-respiratory diseases and cancer risk. However there is now evidence that exposure to SHS is associated with an increased risk of cognitive

impairment, probably also including dementia. At present, 93% of the world's population live in countries that are not fully covered by smoke-free public health regulations, and 35% of people in the world are exposed to SHS (31). Given the prevalence and length of exposure of this potential risk factor for cognitive decline, both education and regulatory approaches appear warranted to protect the future brain health of current populations, then reducing the epidemic of dementia in the world.

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